Chapter 7: Mumps

W. William Schluter, MD, MSPH, Laura Zimmerman-Swain, MPH, and Melinda Wharton, MD, MPH

I. Disease description

Mumps is a viral illness caused by a paramyxovirus of the genus *Rubulavirus.* The classic symptom of mumps is parotitis, most commonly bilateral, which develops an average of 16 to 18 days after exposure.[1] Nonspecific symptoms including myalgia, anorexia, malaise, headache, and low-grade fever may precede parotitis by several days. There is evidence that as many as 40-50% of mumps infections are associated with nonspecific or primarily respiratory symptoms, particularly among children less than 5 years.[2,3] Not all cases of parotitis--especially sporadic ones--are due to mumps infection. Parotitis can also be caused by parainfluenza virus types 1 and 3, influenza A virus, Coxsackie A virus, echovirus, lymphocytic choriomeningitis virus, human immunodeficiency virus, and other non-infectious causes such as drugs, tumors, immunologic diseases, and obstruction of the salivary duct. However, these agents do not produce parotitis on an epidemic scale.

The average incubation period for mumps is 18 days, with a range of 12–25 days.[4] Fever may persist for 3–4 days and parotitis, when present, usually lasts 7–10 days. Persons with mumps are usually considered infectious from 2 days before until 9 days after onset of parotitis. Because mumps can be asymptomatic, the diagnosis is easily missed.

Not all cases of parotitis — especially sporadic cases— are due to infection with mumps virus.

Severe complications of mumps are rare. However, mumps can cause acquired sensorineural hearing loss in children; incidence is estimated at 5 per 100,000 cases. Mumps-associated encephalitis occurs in <2 per 100,000 cases and approximately 1% of encephalitis cases are fatal.

Some complications of mumps are known to occur more frequently among adults than among children. Adults have a higher risk for mumps meningoencephalitis than children. In addition, orchitis occurs in up to 38% of cases in postpubertal males. Although it is frequently bilateral, it rarely causes sterility. Mastitis has been reported in as many as 31% of female patients older than 15 years who have mumps. Other rare complications of mumps are oophoritis and pancreatitis.

Permanent sequelae such as paralysis, seizures, cranial nerve palsies, aqueductal stenosis, and hydrocephalus are rare, as are deaths due to mumps. Although mumps infection in the first trimester of pregnancy may result in fetal loss, there is no evidence that mumps during pregnancy causes congenital malformations.

II. Background

The number of reported mumps cases in the United States has decreased more than 99% since licensure of the mumps vaccine in 1967, from 152,209 cases in 1968 to 666 cases in 1998. Most cases occur among persons 5–19 years of age. Despite the routine vaccination of children with mumps vaccine, outbreaks

have occurred among older children and adults. Although outbreaks in the 1980s were generally attributed to failure to vaccinate all susceptible children, adolescents, and young adults, more recent outbreaks have occurred among highly vaccinated populations.[5,6] In 1991, a mumps outbreak was sustained in a population where 98% of individuals had been vaccinated and where all but one individual with mumps had been vaccinated before the outbreak.[5] Between December 1997 and May 1998, a mumps outbreak occurred in New York City. Among the 111 cases with known vaccination history, 92% had received at least one dose of mumps containing vaccine, and 62% had received two or more doses.[7]

As more children, adolescents, and adults received two doses of measles-mumps-rubella (MMR) vaccine, the number of reported cases of mumps has continued to decrease.[8] Because many reported cases are not confirmed by laboratory testing, it is possible that some reported cases are, in fact, not due to infection with mumps virus. Experience in states that have conducted more complete laboratory testing for confirmation suggests that case investigation, combined with appropriate laboratory testing, will result in many suspected cases being discarded and a resulting decrease in reported mumps morbidity.[9] In the United Kingdom, only 3% of 1333 clinically diagnosed cases were confirmed as mumps by an IgM antibody test, and in Canada, the correlation between the clinical surveillance definition of mumps and the case definition was 28%, indicating very low specificity.[2, 10]

Mumps vaccine is not used routinely in many countries outside the United States, and importation of mumps into this country is now increasingly recognized. In some European countries the Rubini mumps vaccine continues to be used, despite its low efficacy.

III. Importance of rapid case identification

Identification of suspected or confirmed cases of mumps is important in the initiation of control measures to prevent the spread of the disease among susceptible persons.

IV. Importance of surveillance

Information obtained through surveillance is used to follow disease trends in the population, to assess progress towards disease reduction goals, and to characterize populations requiring additional disease control measures.

V. Disease reduction goals

For the year 2000, a disease reduction goal of <500 cases of mumps per year has been established, and a goal of elimination of indigenous mumps by the year 2010 has been proposed.[11]

VI. Case definitions

The following case definition for mumps was approved by the Council of State and Territorial Epidemiologists (CSTE) in June 1999.[12]

Clinical case definition

An illness with acute onset of unilateral or bilateral tender, self-limited swelling of the parotid or other salivary gland, lasting ≥2 days, and without other apparent cause.

Laboratory criteria for diagnosis

- Isolation of mumps virus from clinical specimen, or
- Significant rise between acute- and convalescent-phase titers in serum mumps immunoglobulin G (IgG) antibody level by any standard serologic assay, or
- Positive serologic test for mumps immunoglobulin M (IgM) antibody.

Case classification

Probable: A case that meets the clinical case definition, has noncontributory or no serologic or virologic testing, and is not epidemiologically linked to a confirmed or probable case.

Confirmed: A case that is laboratory confirmed or that meets the clinical case definition and is epidemiologically linked to a confirmed or probable case. A laboratory-confirmed case does not need to meet the clinical case definition.

Comment. False-positive IgM results by immunofluorescent antibody assays have been reported.[13]

VII. Laboratory testing

Acute mumps infection can be confirmed by a significant rise in IgG antibody titer in acute and convalescent serum specimens, by the presence of mumps-specific IgM, or by viral culture. Diagnostic tests used to confirm acute or recent mumps infection include serologic tests, such as enzyme-linked immunosorbant assay (EIA), complement fixation (CF), hemaglutination inhibition (HI), indirect flourescent antibody assay (IFA), and isolation of mumps virus from clinical specimens.

Sera should be collected as soon as possible after onset of parotitis for IgM testing or as the acute specimen for examining seroconversion. The convalescent specimen for IgG detection should be drawn about 2 weeks later. IgM antibodies are detectable within the first few days of illness, reach a maximum level about a week after onset of symptoms, and remain elevated for several weeks or months.[14,15]

Immunity to mumps may be documented by the presence of serum IgG mumps-specific antibodies by EIA, or viral neutralization. Virus may be isolated from the buccal mucosa from 7 days before until 9 days after salivary enlargement, and from urine during the period from 6 days before to 15 days after the onset of parotitis.[4]
For additional information on use of laboratory testing for surveillance of vaccine-preventable diseases, see Chapter 19.

Serologic testing

The serologic tests available for laboratory confirmation of mumps infections vary among laboratories. The health department can provide guidance in available laboratory services and preferred tests.

- **Enzyme-linked immunosorbant assay (EIA).** EIA is a highly specific test for diagnosing acute mumps infection and mumps immunity. At present, there are no FDA-approved EIA tests for detection of mumps IgM antibodies. At the direction of the state health department, health-care providers and state and local health departments may send serum specimens from patients in whom the diagnosis of mumps is suspected to the CDC Mumps Laboratory for IgM detection by EIA.

- **Complement fixation (CF).** Although CF tests are useful in detecting certain mumps antigens, they are not reliable for determining mumps immunity and should not be used for screening purposes.[4]

- **Hemagglutination inhibition test (HI).** As in the case of CF tests, HI tests cannot be used to assess immunity to mumps and should not be used for screening purposes. A rise in mumps HI titer can be used to diagnose mumps infection, but anamnestic responses may occur during parainfluenza infections.[4]

- **Virus neutralization.** Virus neutralization may be used for determining acute mumps infection and mumps immunity. However, this is a complex assay and takes approximately 1 week to perform. For these reasons, it is not widely available.[4]

Viral cultures

Mumps virus can be isolated from throat swabs, urine, and cerebrospinal fluid (CSF). Efforts should be made to obtain the specimen as soon as possible after parotitis onset. Although mumps virus culture is rarely performed for clinical diagnosis in uncomplicated cases, the virus is readily isolated from CSF in cases of mumps meningitis. However, molecular typing of virus isolates provides epidemiologically important information and is now recommended (see below).

Molecular typing

Molecular epidemiologic surveillance allows us to determine the origin of the

virus and virus strains circulating in the U.S. In addition, typing methods are available to distinguish wild-type mumps virus from vaccine virus. Specimens for molecular typing should be obtained from the buccal mucosa with nasophayngeal swabs and from urine as soon as possible after the onset of parotitis, from the day of onset to 3 days later. Specific instructions for specimen collection and shipping may be obtained from the CDC by contacting the Rubella/Mumps Activity, National Immunization Program, (404) 639-8230. Specimens for virus isolation and molecular typing should be sent to CDC as directed by the state health department.

VIII. Reporting

Each state and territory has regulations and/or laws governing the reporting of diseases and conditions of public health importance (Appendix 2).[16] These regulations/laws list the diseases that are to be reported, and describe those persons or groups who are responsible for reporting, such as health care providers, hospitals, laboratories, schools, day care facilities, and other institutions. Contact your state health department for reporting requirements in your state.

Reporting to CDC

A provisional report of probable and confirmed cases should be sent to the National Notifiable Diseases Surveillance System by the state health department via the National Electronic Telecommunications System for Surveillance (NETSS). Reporting should not be delayed because of incomplete information or lack of confirmation; following completion of case investigations, data previously submitted to NETSS should be updated with the available new information.

Information to collect

Basic demographic information (age, race/ethnicity, sex, county, and date of onset) and mumps vaccination history allow cases to be characterized and also allow identification of groups at increased risk of disease.

In most states, resource limitations have prevented routinely obtaining laboratory confirmation or conducting detailed case investigations of mumps cases. However, recent experience in one large state suggests that if such an effort is undertaken, many reported cases will be found not to be cases of mumps.[9] In cases for which laboratory testing is done, final laboratory results may not be available for the initial report but should be submitted when available.

The following data are epidemiologically important and should be collected in the course of case investigation. Additional information may be collected at the direction of the state health department.

- Demographic information, including country of origin and time of residence in the U.S.

- Vaccination status including
  - —Number of doses of mumps vaccine
  - —Date(s) of mumps vaccination
  - —If not vaccinated, describe reason

- Risk factors for disease including
  - —Transmission setting (i.e., infection acquired in day care, school)
  - —Relationship to outbreak (i.e., is case part of an outbreak or is it sporadic case)

- Source of exposure and travel history [i.e., import status (indigenous, international import, or out-of-state import, state name, country name)]
  - —Contact with a probable or confirmed case
  - —Contact with immigrants or travelers

- Clinical presentation including
  - —Date of onset of symptoms, especially parotitis
  - —Duration of parotitis
  - —Complications (e.g., meningitis, deafness, encephalitis, orchitis)

- Laboratory information including
  - —Viral isolation
  - —Serologic test results with IgM or IgG (indicating a significant rise between acute and convalescent samples)

IX. Vaccination

Live attenuated mumps virus vaccine is recommended for persons $\geq$ 12 months of age unless medically contraindicated or unless a person is immune as defined by documentation of 1) physician-diagnosed mumps, 2) immunization with at least one dose of mumps vaccine on or after the first birthday, 3) serological evidence of mumps immunity, or 4) birth in or before 1957. With use of MMR for measles vaccination under the currently recommended two-dose schedule, most children and adolescents now receive two doses of mumps vaccine. Mumps vaccine, as MMR, is recommended at 12–15 months of age and 4–6 years of age.[17]

X. Enhancing surveillance

Obtain accurate and complete immunization histories. Mumps case investigations should include complete immunization histories that document any doses of mumps-containing vaccine.

Expanding laboratory testing. One large state's experience suggests that routine use of laboratory testing for confirmation of mumps cases and of case investigation will result in a marked reduction in reported cases of mumps.[9] If resources permit case investigations with appropriate laboratory testing to be performed, the quality of data obtained on mumps cases can be substantially improved.

Promoting awareness that mumps outbreaks have occurred in highly vaccinated populations. Outbreaks of mumps have occurred among highly vaccinated populations; therefore, mumps should not be ruled out on the assumption that individuals are already immune due to vaccination.

Active surveillance. In outbreak settings, active surveillance for mumps should be maintained for at least two incubation periods following parotitis onset of the last case.

A number of other activities can improve the detection and reporting of cases and improve the comprehensiveness and quality of reporting. For general information on improving surveillance of vaccine-preventable diseases, see Chapter 16.

XI. Case investigation

The Mumps Surveillance Worksheet (Appendix 11) may be used as a guideline to collect case information during a case investigation. Essential components of the case investigation include the following:

Establish a diagnosis of mumps. Because clinical diagnosis of mumps may be unreliable, cases of mumps should be laboratory confirmed. Not all cases of parotitis, especially sporadic ones, are due to mumps infection; however, mumps is the only known cause of epidemic parotitis. Experience indicates that case investigations combined with laboratory testing will result in many suspected mumps cases being discarded.

Obtain accurate and complete immunization histories. Mumps case investigations should include complete immunization histories that document any doses of mumps-containing vaccine. Recent outbreaks of mumps have occurred among older children and adults, many who had already received at least one dose of mumps-containing vaccine.

Identify the source of infection. Efforts should be made to identify the source of infection for every confirmed case of mumps. Case-patients should be asked about contact with other known cases. When no history of contact with a known case can be elicited, opportunities for exposure to unknown cases should be sought. Investigating sources of exposure should be directed to the place and time period in which transmission would have occurred.

Assess potential transmission and identify contacts. As part of the case investigation, the potential for further transmission should be assessed, and contacts of the case-patient during the infectious period (2 days before until 9 days after onset of parotitis) should be identified.

Obtain specimens for virus isolation. Efforts should be made to obtain clinical specimens (throat swabs, urine, and CSF) for viral isolation for all cases or at least some cases in each outbreak at the time of the initial investigation. Virus may be isolated from the buccal mucosa from 7 days before until 9 days after salivary enlargement, and from urine during the period from 6 days before

to 15 days after the onset of parotitis.

XII. Outbreak control

Mumps is the only known cause of epidemic parotitis. The main strategy for controlling a mumps outbreak is to define the at-risk population and a transmission setting, and to rapidly identify and vaccinate susceptible persons or, if a contraindication exists, to exclude susceptible persons from the setting to prevent exposure and transmission.

Mumps vaccine, preferably as MMR, should be administered to susceptible persons. Although mumps vaccination has not been shown to be effective in preventing mumps in persons already infected, it will prevent infection in those persons who are not infected. If susceptible persons can be vaccinated early in the course of an outbreak, they can be protected. However, cases are expected to continue to occur among newly vaccinated persons who are already infected for at least 3 weeks following vaccination because of the long incubation period for mumps.[18]

As with all vaccines, there are some individuals who will not gain immunity after receipt of mumps vaccine. Because vaccine effectiveness is not 100%, a second dose of mumps containing vaccine is recommended during outbreak situations for individuals who have received only one dose previously. Furthermore, birth after 1957 does not guarantee mumps immunity, and in outbreak settings vaccination with a mumps containing vaccine should be considered for those born before 1957 who may be exposed to mumps and who may be susceptible. ❖

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